CLAIMS

A method of determining flow rates in a multiphase fluid flowing in a well, comprising:

(i) measuring local speed of the flowing fluid in a region of the well; and

(ii) measuring local proportions of the fluid flowing in a region of the well;

wherein the region in which the local speed is measured and the region in which the local properties are measured lie in a vertical plane of the well;

characterised in that the method comprises measuring both local speed and local proportions of the phases in at least two regions that lie in a vertical plane of the well which includes the longitudinal axis of the well and are offset from each other parallel to the axis of the well.

A method as claimed in claim 1, comprising measuring local speed and local proportions of phases at regions distributed across the entire width of the well.

A method as claimed in claim 2, wherein the well is inclined from vertical, the method comprising measuring local speed and local proportions of phases at a region lying at the bottom of the vertical plane of the well, and measuring local speed and local proportions of phases at other regions distributed across the entire width of the well in the vertical plane.

A method as claimed in claim 3, further comprising measuring local speed and local proportions of phases at a region lying at the bottom of the vertical plane of the well

A method as claimed in claim 1, in which a section element (Δsi) of the well is assigned to each region, and the overall flow rate Q of each phase is determined from the relationship:

$$Q = \sum_i q_i \cdot \frac{\Delta si}{S}$$

where S is the total vertical section of the well

and q_i is the flow rate of each phase in section element Δsi,

with $q_i = v_i.h_i$

where v_i is the local speed of each phase in section element Δsi

and h_i is the local proportion of each phase in section element Δsi.

A method as claimed in claim 16, comprising measuring the local speed and local proportions of the phases at the same point in each region.

A method as claimed in claim 16, comprising, in each region, measuring local speed and local proportions of phases in different locations that are aligned with each other parallel to the longitudinal axis of the well.

Apparatus for determining flow rates in a multiphase fluid flowing in a well, comprising:

(i) a tool body to be positioned in the well;

(ii) sensor means mounted on the tool body for measuring local speed of the flowing fluid in a region of the well; and

(iii) sensor means mounted on the tool body for measuring local proportions of the fluid flowing in a region of the well;

wherein the region in which the local speed is measured and the region in which the local properties are measured lie in a vertical plane of the well;

characterised in that sensor means are provided for measuring both local speed and local proportions of the phases in at least two regions that lie in a vertical plane of the well which includes the longitudinal axis of the well and are offset from each other parallel to the axis of the well.

Apparatus as claimed in claim 8, wherein, in use, the sensor means for measuring local speed and local proportions of phases at regions distributed across the entire width of the well.

Apparatus as claimed in claim 9, wherein when the well is inclined from vertical, sensor means are provided for measuring local speed and local proportions of phases at a region lying at the bottom of the vertical plane of the well and for measuring local

speed and local proportions of phases at other regions distributed across the entire width of the well in the vertical plane.

11 Apparatus as claimed in claim ~~10~~, further comprising sensor means are provided for measuring local speed and local proportions of phases at a region lying at the top of the vertical plane of the well.

12 Apparatus as claimed in claim ~~9~~, further comprising means for orienting the tool body such that the sensor means lie across the entire width of the well in the vertical plane.

13 Apparatus as claimed in claim ~~8~~, wherein, in use, the tool body rests under the influence of gravity, against the bottom of the well, and including at least one deployable arm supported by the body at one end and capable of being applied against the top of the well, in which at least some of the sensor means for determining the local speed of the fluid and at least some of the sensor means for determining the local proportions of the phases are mounted on the deployable arm.

14 Apparatus as claimed in claim ~~8~~, wherein, in use, the tool body is centered about the axis of the well by centering means including at least two deployable arms mounted on the body and capable of being applied respectively against the bottom and top of the well, in which at least some of the sensor means for determining the local speed of the fluid and at least some of the sensor means for determining the local proportions of the phases are mounted on the deployable arms.

15 Apparatus as claimed in claim ~~8~~, wherein the sensor means comprise multi-sensor assemblies, each including the means for determining the local speed of the fluid and the means for determining the local proportions of the phases.

16 Apparatus as claimed in claim ~~8~~, wherein, in use, the sensor means for determining the local speed of the fluid and the sensor means for determining the local proportions of the phases are mounted in distinct locations in each region that are substantially in alignment with each parallel to the axis of the well.

Respectfully submitted,

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